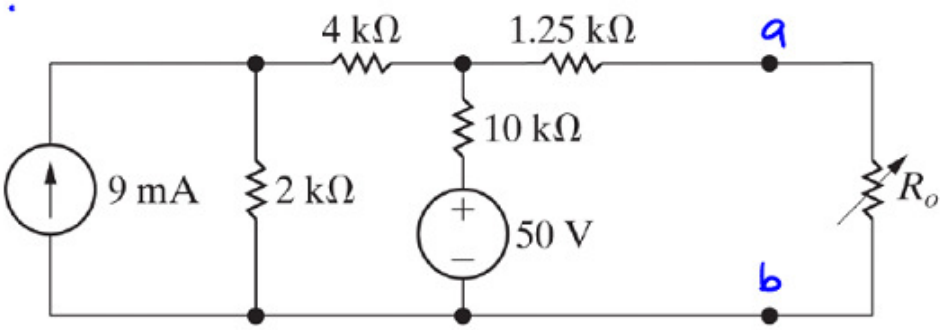
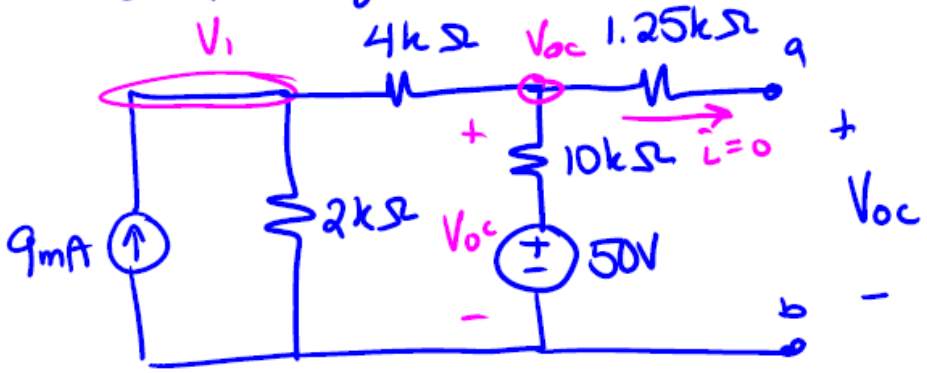
Homework Set #16
DUE Monday, April 24, 2017

1. Recall that maximum power transfer occurs when $R_L = R_{Th}$. The rheostat (R_0) is adjusted to give maximum power transfer.

a) Find the value of R_0.
b) Find the maximum power that can be delivered to R_0.



Find Thev eq. ckt



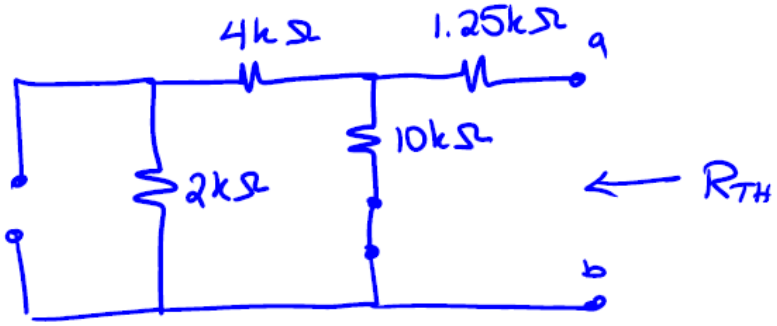
KCL V_1) $\quad -9m + \frac{V_1}{2k} + \frac{V_1 - V_{oc}}{4k} = 0$

KCL V_2) $\quad \frac{V_{oc} - V_1}{4k} + \frac{V_{oc} - 50}{10k} = 0$

$V_1 = 22\ V$

$V_{oc} = 30\ V \Rightarrow \boxed{V_{TH} = 30V}$

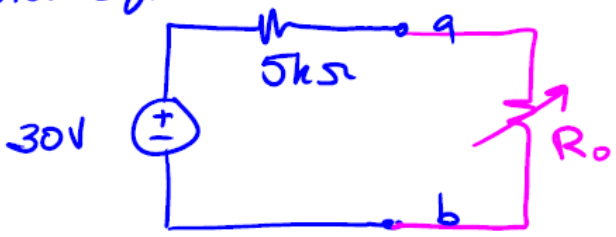
Find R_{TH} direct method (zero sources)



$R_{TH} = (4k + 2k) \| 10k + 1.25k$

$\boxed{R_{TH} = 5k\Omega}$

Thev eq.



set $R_o = R_{TH}$ for max power

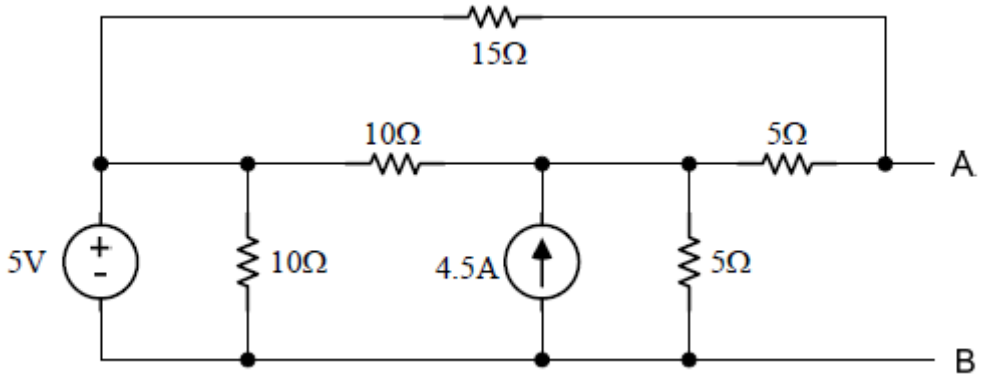
$\boxed{R_o = 5k\Omega}$

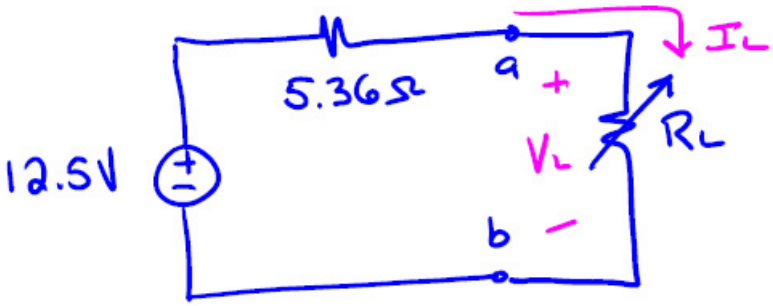
b) $V_L = 30 \frac{1}{2}$

$P_L = V_L^2 / R_o$

$\boxed{P_L = 45mW}$

2. In order to provide a graphical verification of the Maximum Power Transfer Theorem, plot (EXCEL, MATLAB or MAPLE) the power P_L extracted from this circuit (in other words, the power absorbed by a load resistor, R_L, connected across terminals A-B) as a function of the load resistance R_L as R_L is varied between 0.25 R_{Lmax} and 4R_{Lmax}. Your plot should reveal that P_L is at a maximum when $R_L = R_{Lmax}$. *Hint: you found the Thevenin equivalent of this circuit in homework 14.*



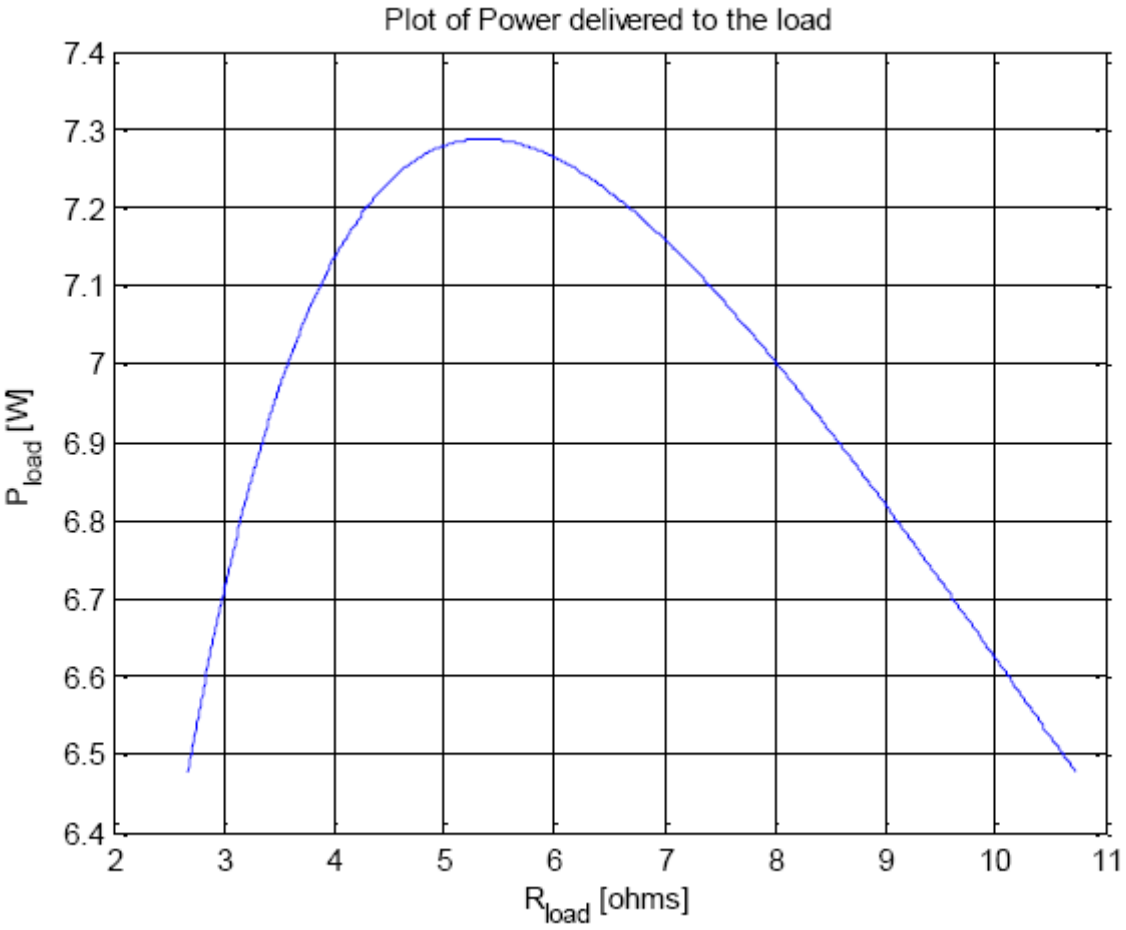


$$V_L = 12.5 \frac{R_L}{5.36 + R_L} \qquad I_L = \frac{12.5}{5.36 + R_L}$$

$$P_L = \frac{V_L^2}{R_L} = \left(\frac{12.5}{5.36 + R_L}\right)^2 R_L$$

or

$$P_L = I_L^2 R_L = \left(\frac{12.5}{5.36 + R_L}\right)^2 R_L$$


Plot of Power delivered to the load
7.4
7.3
7.2
7.1
7
6.9
6.8
6.7
6.6
6.5
6.4
P load [W]
2
3
4
5
6
7
8
9
10
11
R load [ohms]